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DIFFERENT WAYS OF TRANSMISSION IN ROBOT

1.Prof. M.V. Chole, 2. Raghav Tiwari, 3. Ravi Shripad, 4. Siddesh Dhande, 5. Syed Zaid Hussain, 6. Ayush Zade
E-mail: raghavtiwari1002@gmail.com, zayush998@gmail.com
Department of Artificial Intelligence and Data Science, Karamveer Dadasaheb Kannamwar College of Engineering Nagpur, India

ABSTRACT

Nowadays robots are taking the place of human in performing the task or work. As we need robots in different fields so we can categorise the robots according to their work and transmission way. The categories can be defined in four different types which are Motor-driven robot, String-driven robots, Gear-driven robots and fluid-driven robots. Driven means the transmission. Using a real-world analogy like vehicle transmission which means the mechanism by which power is transmitted from one end to another. Motor-driven robots can be defined as the robots which uses motor to move its parts and perform task. String-driven robots are those robots that uses string to move or perform task. Gear-driven robots are those robots which uses gear and shaft for power transmission. Fluid-driven robots are those robots which uses fluid such as liquid or gas for power transmission. Task means a piece of work that must be done. For efficient power consumption and effective work quality we must use different transmission techniques by which we can save power and energy. Hence Motor-driven robots are easy to build, String-driven required less space hence it decreases the size of robot, Gear-driven robot can manage to do work with single power source and a Fluid-driven robot can manage to perform tasks that includes heavy objects. Hence by this study we can conclude that we must use different transmission techniques for building the robot by which we can enhance the work efficiency and decrease power consumption.

INTRODUCTION

Robots are coming in day-to-day life we have also start excepting the robot in our life the robot can be semi-automatic robot and fully automatic robot. Semi-automatic robot can perform work specific task. Fully automatic robot uses advance AI and deep learning techniques with built in sensor which helps in real time processing by which robot can work effectively or work as a human. Hence robot is machine which cannot think it can only predict with real time processing and complex algorithm design. We can keep our robot one hand ahead of work. This was all about outer processing before the work is done. When it comes to internal processing of robot the scenario changes. Every part of robot must work in coordination and time specific to improve work efficiency. Hence when it comes about the robot's internal work the good quality of robot must be able to perform 6 DOF (degree of freedom). Which means the robot must have ability to manage to do work in all directions. When it comes for doing work in all directions the transmission technique comes in scenario. Transmission means transferring the mechanical power from one end to another end. With considering transmission techniques we can categorise robot into 4 different types:

1. Motor driven robot
2. String driven robot
3. Gear driven robot
4. Fluid driven robot

The Motor driven robots are easy to build, and coordination of work can be balanced. The String driven robot requires less space for power transmission hence can work as an exoskeleton. The Gear driven robot can manage heavy work with single power source and less maintenance. The Fluid driven robot required less space for power transmission and can work with heavy task management, hence the capability of every transmission technique is different, so their advantages and disadvantages also vary with their techniques. Using different techniques we can improve work efficiency.

DESCRIPTION

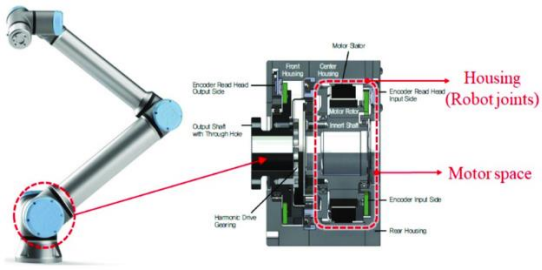
Nowadays robots are being used in day-to-day life, so to boost the robot quality and work efficiency we can enhance transmission way. Therefore, we have categorised the robots in four types according to their transmission capabilities the types are motor driven robot, string driven robot, gear driven robot and fluid driven robot. Now we will learn about these types of robots in detail.

1. **Motor-driven robot:**

Motor driven robots are those robots which uses electrical motor for their power transmission. The most common example of motor driven robot is servo motor. In this the motor generally takes DC current as input. Current generates magnetic field in the wire which causes the motor to rotate. The rotation with calculated time and angle using microcontroller robot perform particular angle task. In some motor driven robot, we use small gear to enhance the power output by calculating rpm to torque output ratio, hence increasing the force at particular angle. Torque is a measure of force that can cause an object to rotate about an axis.

The benefits of using motor driven robot is that it is easy to build hence components like servo motor have widespread in the market with precise time and torque which makes it the developer's first choice to adopt it. The servo motor also come in cheap cost, different size and models hence the torque to force ratio are also different. The developer can easily make choice for which part to be used at which place. Controlling different servo motor is simple. Taking instructions from processor and tracking their movement is also easy and simple. Here are some examples:

- **Humanoid robots: ASIMO, Atlas**
- **Mobile robots: Roomba, Mars rover**
- **Quadrupeds: Spot, MIT mini cheetah**
- **Robotic Arm: KUKA robotic arm, UR5**
- **Robotic Vehicle: Tesla full self-driving system**

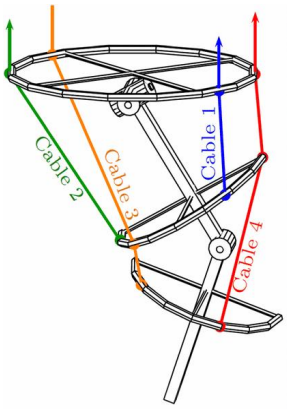


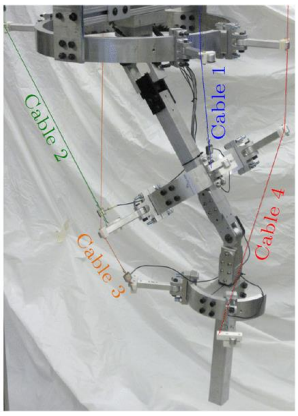
2. **String-driven robot:**

String driven robots are those robots which can use one power source. The power is being transmitted using string. With the help of pulley, we can reduce the friction in the joint to save power. The string must be flexible strong material like conductive nylon thread. These threads are twisted and coiled to form actuator that can generate high tendon-based linear actuation and forces, making them suitable for robotics applications like robotic hands and exoskeleton. The string driven robot are generally used in exoskeleton robot. This type of robots are those robots which we have to make and keep its framework hollow from inside. Thus, hollow place in the robot can be utilised for other works.

There are many benefits of string driven robot. The benefits are as follows:
The string driven robot uses string so it can easily be able to control the minute tip of robot hence it can work with one power source. With proper complex programming to manage the different string which can make our model lightweight or hollow from inside. Thus, we can get extra space for storage for implanting different equipment and sensor. The string driven robot is most commonly used as exoskeleton robot which helps the framework to reduce effort and make the framework capable of managing difficult tasks. Some examples of string driven robots are:

- **String-driven parallel robot: Festo bionic handling assistant**
- **String-driven robotic hands: Shadow dexterous hand**
- **String-driven quadruped robot: MIT's cheetah robot (early access)**
- **Soft robotic exoskeletons: HARL Exoskeleton by Havard**
- **Robotic dog with string actuation: Stanford's Pupper**
- **Cable-driven parallel robots: Flying camera robots (sky Cam)**
- **String-based soft robots: Havard's Soft robotic hand**

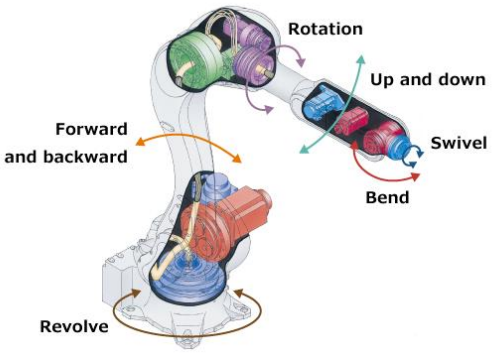




3. **Gear-driven robot:**

Gear driven robots are those robots which uses gear and shaft for power transmission. In this type of robot, we can use single power source. The power source can be motor base or engine base. We are using gear which help the robot to lift heavy object since, its tensile strength is much more than any other model. It can manage to do hard and heavy work without breaking its framework for longer time. Comparing to fluid driven robot the execution time of this robot is also good. For building this type of robot we must have complex algorithm with control in every connecting and disconnecting shaft. These kinds of robots are difficult to build but its benefits are far better. Thus, this type of robot lack in minute tip control but the hybrid model of robot can solve this problem. The benefits of gear-driven robots are numerous, they are as follows:

The gear-driven robots can perform precise motion, smooth operations and can manage to handle heavy work. In gear driven robot we can install single power sourcelike engine. The power required to start each power source can be decreased, which can lead to save the energy. The gear driven robot can manage to transfer heavy object with smooth driving. Execution time at each joint is also less which makes this type of robot smooth driving. The gear-driven robot can withstand the harsh environment and require less maintenance; hence this model is based on mechanical movement. Some examples of gear-driven robot are:



- **Quadruped: BigDog by Boston Dynamics**

- **Robotic arm: Fanuc, ABB**
- **Educational robots: VEX robotics robots**
- **Exoskeletons: ReWalk, Ekso Bionic**
- **Industrial robots: SCARA robots, 6-Axis robotic arms**
- **Hobbyist robots: LEGO Mindstorms robot**

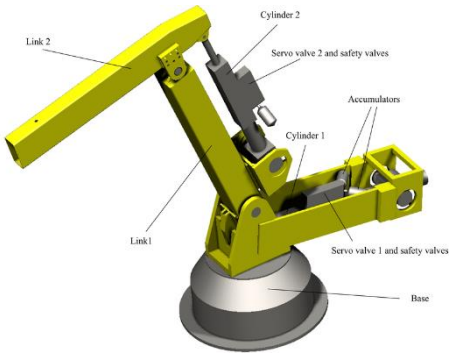
4. **Fluid-driven robot**

Fluid-driven robots are the robots which uses hydraulic energy for the movement. The movement generated by hydraulic depend upon the capacity of pump used in the model. Which means the pump's design and operational condition includes the flow rate, pressure and the type of hydraulic fluid used. Although the small form can be installed in big model, but operational and mechanical movement will slowdown. The hydraulic pump works on "Pascal's law". Pascal's law state that pressure applied to confined fluid is transmitted equally in all direction allowing the conversion of mechanical power to hydraulic energy. Fluid-driven robot is being controlled with microcontroller and hybrid AI and Deep learning model which enhance it capability of performing the minute task. Thus, it can work as both type of robots normal and exoskeleton robot although the robot capability is numerous, but the limitation only depends upon the hydraulic pump walls and pipe. Hence good pipe which. withstand the large pressure with small diameter considered as best option for our model.

The benefits of these type of robots are numerous and are as follows:

The hydraulic robot can use to do tasks which require more power or force. The robot can withstand the high outer pressure thus, suitable for deep sea exploration as it can withstand high pressure. The fluid-driven base supports high pressure exerted in outer body. All the pipes also withstand the same pressure inside, and outside which help the robot to be the first choice for deep sea exploration. The examples of fluid-driven robot are as follows:

- **Soft robots: Havard Octobot, Pneumatic Grippers**
- **Bio-Inspired robots: Robotic fish, Snake-like robots**
- **Medical robots: Soft Exosuits, Minimally Invasive surgical tools**
- **Underwater exploration robots: Deep Sea crawlers**
- **Space robots: NASA's soft robot prototype**



CONCLUSION

In the machine transmission system is very necessary nowadays the change in transmission way can save energy and increase performance. Performing the complicated talks will also be easy. The motor-driven transmission system is easy to build, but it can fail in harsh condition as it require excellent maintenance. The string-driven Robot is excellent as exoskeleton type robot but the string with time gets degraded and requires a periodic maintenance. The gear-driven robot is excellent in all condition but operating and managing the rpm is difficult, minute extra torque can cause the system collapse. The fluid-driven robot is excellent in deep sea exploration and lifting heavy object but the execution time to do work will be time consuming if you want to decrease the execution time then we have to use more power source which make the system to consume more power. By this we can figure out that using the combination of different transmission in the model is

necessary to make the model cost efficient, sustainable and increase its performance. Thus, we must use the hybrid model for the transmission in the robot.

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